Volume Title: The Quality and Economic Significance of Anticipations Data

Volume Author/Editor: Universities-National Bureau

Volume Publisher: UMI

Volume ISBN: 0-87014-301-8

Volume URL: http://www.nber.org/books/univ60-1

Publication Date: 1960

Chapter Title: Quantitative Evidence For The Interwar Period On The Course Of Business Expectations: A Revaluation Of The Railroad Shippers' Forecast

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Chapter URL: http://www.nber.org/chapters/c6598

Chapter pages in book: (p. 205 - 238)

Quantitative Evidence for the Interwar Period on the Course of Business Expectations: A Revaluation of the Railroad Shippers' Forecast

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Of the many sins of method with which economists are charged, few should concern us more than the accusation that when facts are hard to explain, we take refuge in irrefutable allegations. A widely accepted rule for avoiding this sin calls for dealing only in "observable" magnitudes. But following the rule has tended to exclude the intuitively attractive possibility of interpreting events in terms of expectations, on the ground that expectations were not observable.

For the postwar period, the discipline of confrontation with evidence has been extended to many interpretations that rest on expectations, since the rapid growth of expectational statistics has greatly broadened the range of empirical testing. But the postwar data arise from surveys that tap the informant after his expectations are framed and before the anticipated events take place. Expectations not picked up currently can be reconstructed only as we can find documentary traces. And while many traces exist, most of the evidence about expectations held in the past is so scattered and fragmentary as to defy analysis. Thus it seemed until recently that explanations through expectations of events before World War II must remain in the limbo of the unobservable.

However, one broad expectations survey, at least, goes back as far as 1927. In years when economists regarded anticipations as only a matter for speculation, practical men concerned with railway traffic were already collecting and publishing a quarterly survey of the freight-car requirements foreseen by traffic managers for each oncoming quarter year.[1] The survey by the railroad shippers' advisory boards seems to have preserved a high degree of comparability, with slight and infrequent changes in commodity classification and methods of compilation, over most of its thirty-year span—the longest span incidentally of any expectations series

[1] *National Forecast of the Regional Shippers' Advisory Boards Concerning Freight-Car Requirements: Estimated Percentage Increase or Decrease as Compared with Actual Carloadings Same Quarter Last Year*, Association of American Railroads, Car Service Division. The bulletin appears quarterly a week or two after the opening of the quarter for which estimates are made.

Note the reference in the title to a percentage-change comparison with the corresponding quarter of the previous year; this is crucial to the argument of the present paper.

surveyed by the students of the subject so far. And with its thirteen regions and fairly detailed commodity breakdown, the survey offers over two hundred separate nonagricultural series for analysis. While a far from perfect substitute for a sample of returns from individual informants, this richness of structure gives us some prospect of getting inside the aggregates and tracing changes in the dispersion of anticipations.[2]

Previous Studies

DISCOURAGING RESULTS OF FERBER AND HULTGREN

The pessimistic findings of the pioneer studies by Hultgren and Ferber have discouraged an intensive study of this body of evidence.[3] Hultgren was concerned primarily with the predictive value of the forecasts for estimating actual railway traffic. He concluded that working merely from observed seasonal patterns of the actual carloadings "a simple mechanical procedure yields estimates of total traffic that are somewhat less erroneous on the average than the estimates obtained by the elaborate advisory board procedure."[4] Ferber was more concerned with the relation of anticipations to the experience out of which they grow, and he found that "in effect the shippers in the aggregate expect a sharp reversal of trend which will erase more than half of the gain (or loss) from A_{t-5} to A_{t-1}."[5] As to direct forecasting value, like Hultgren he found that estimates made by extrapolation alone systematically showed smaller errors than did the shippers' forecasts themselves, in the interwar period.[6]

On the face of these findings, the shippers' forecasts for the interwar period would seem of little value. If they really embody the expectations by which business operated, they ought to show coherent relationships both to antecedent and to ensuing events. We dare not be too utopian in our standards of "coherence": reported expectations cannot be both a good image of what businessmen expected and a good forecast of actual events unless businessmen were good prophets. The well-known fact that

[2] The National Bureau's array of current diffusion indexes includes a carloadings index computed from the nineteen national totals for nonfarm commodities in the postwar bulletins. If the clerical effort were thought worthwhile, the number of items could be expanded to rather over two hundred (19×13 less a few blanks) by using regional figures in detail; and the time span could be carried back to 1927.

[3] Thor Hultgren, "Forecasts of Railway Traffic," *Short-Term Economic Forecasting*, Princeton University Press for the National Bureau of Economic Research, 1955; and Robert Ferber, *The Railroad Shippers' Forecast*, University of Illinois Press, 1953.

[4] P. 377.

[5] P. 91. In Ferber's convenient notation, A_t is an actual magnitude of period t, E_t an expected magnitude for the same period. E_t is viewed as *framed* in period $t-1$. (The Appendix to this paper contains all the symbols used and their definitions.)

[6] P. 60. Ferber did find (pp. 61 and 131-132) that the postwar data showed more predictive value. But this is cold comfort. We have alternative sources of postwar expectations data. It is for the interwar years that the shippers' forecast, if a valid measure of expectations, would be uniquely valuable, because for those years we have only fragments from other sources.

inventory expansion runs past peaks into downswings and its contraction past troughs into upswings shows major errors of foresight. And so does the substantial influence of business fluctuations upon stock prices. Yet if the shippers' forecasts were really segments of business operating plans, how could they be so completely devoid of forecasting value (Hultgren) or so paradoxically related to past experience (Ferber)? Did the firms lack coherent operating plans? Or if they had such plans, did their traffic managers fail to transmit them through their forecasts?

Motivated perhaps by a vested interest in expectations, I went behind the results of the pioneer studies and restudied the data by methods which reflect the structure of the advisory board surveys.[7] While I have been able to process too little of the data to obtain conclusive results, my revaluation suggests that the forecasts did embody valid information about coherent operating plans, and that we can bring this information to the surface by correcting for certain standing biases. I find that the shippers' forecasts for the interwar period:

1. Predicted well at times when it is reasonable to suppose that operating plans could be executed.
2. Failed to predict at turning-points in just the way a true measure of the expectations of fallible businessmen should.
3. Embodied a coherent and reasonable extrapolative relation to antecedent experience, together with valid nonextrapolative elements.

My general conclusion is that we seem to have here a body of data which may enable us to test against evidence many hypotheses that have been regarded as nonrefutable.

BASIS FOR THE PESSIMISTIC FINDINGS

The pessimistic findings of the two pioneer studies, it should be pointed out at once, have evidence behind them. By a simple graphical technique (Chart 1), we can see their basis in the original data.

The continuous curve at the top of the chart shows Ferber's compilation of actual carloadings for all manufactured products from 1927 through 1941 with my seasonal adjustment.[8] Comparison with the Federal Reserve Board index of manufacturing production (lower curve) shows extremely close conformity of shape most of the way across the chart, with two exceptions:

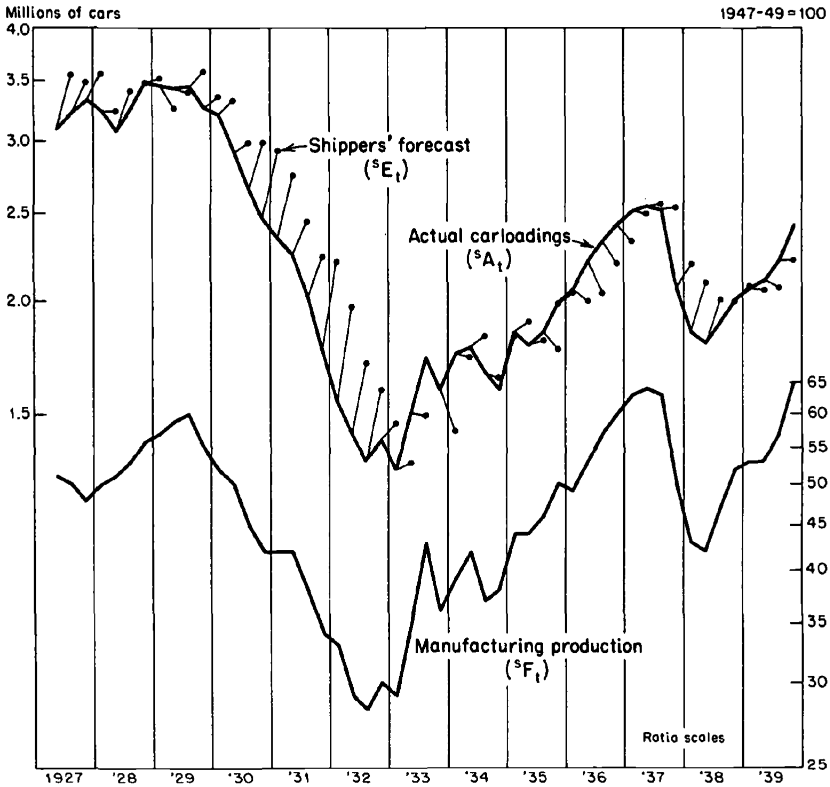
1. At the beginning of the series, the high level of carloadings shown for I 1927 seems to have no warrant in the production series—perhaps because the survey did not shake down at once to its permanent pattern.

[7] For an account of the way the surveys are made, see Ferber, pp. 15-21.

[8] I adjusted the data for seasonal fluctuations using a moving seasonal derived from ratios to moving averages. The coefficients used, together with data before and after seasonal adjustment, are shown in Appendix Table A-1.

CHART I

Actual and Shippers' Forecast Carloadings, All Manufactured Products and Manufacturing Production, Quarterly, Seasonally Adjusted, 1927–1941



2. At the end of the interwar period, reported actual carloadings fail to share the vigorous rise of production in 1940-41. There may well have been a marked relative shift, in view of the intensified level of fabrication of manufactures and the relative growth of products which were self-transporting. Yet we cannot rule out the possibility that the "actual" carloadings of 1940-41 lacked comparability with those of 1927-39.

Consequently I limited my analysis to data from II 1927 through IV 1939.

Each forecast (for the same total of carloadings with the same seasonal adjustment) is shown as a point—tied back by a thin line to the actual level of the previous quarter. Each thin line can be seen as an abortive projection of the solid curve, showing how it would have continued had the results of the survey added up to a perfect forecast.

If our only concern were the general level of carloadings, we might view the stub lines merely as a bit of fuzz clinging to the continuous curve of actual carloadings, and assert that the forecasts give a fairly good picture of the actual level.[9] Obviously there is a high correlation ($r^2=0.84$) between the estimated level ${}^sE_t$ and the actual level ${}^sA_t$ in the seasonally adjusted series. Unfortunately for the value of the raw forecasts, however, the correlation is considerably weaker than the one obtained on the naïve-model hypothesis that ${}^sA_t$ is related to the preceding observation ${}^sA_{t-1}$($r^2=0.94$). Furthermore, a *joint* use of ${}^sE_t$ and ${}^sA_{t-1}$ to predict ${}^sA_t$ yields an imperceptible partial correlation ($r^2_{{}^sA_t{}^sE_t \cdot {}^sA_{t-1}}=0.02$) for ${}^sE_t$. We are forced to conclude that the raw forecast has no *net* predictive value for the level of carloadings.[10]

As forecasts of quarter-to-quarter changes, the thin lines indicate an almost perfect record of failure. It almost looks as if the shippers had followed the cheap but infallible rule for being right at turning-points (at the expense of being wrong all the rest of the time) by always predicting a turning opposite to the last turn observed. During recessions, the raw forecasts not only are too high, but they keep saying, "Beginning next quarter we will be on the upgrade again." Conversely during upswings, almost all the thin lines point downward. Thus the forecasts seem "regressive" in the classical sense, as Ferber points out. Instead of recognizing that a swing in progress may continue, they seem uniformly to point to some sort of reversion toward a norm.

The Shippers' Forecasts as Four-Quarter Estimates

Before we write off the shippers' forecasts as useless, however, we must examine them for what they purport to be. To look at them as estimates of quarter-to-quarter change may misrepresent them. For the whole emphasis of the survey is on comparison of the oncoming quarter with the same quarter in the previous year. What we have before us is a body of consistently biased four-quarter-change estimates.

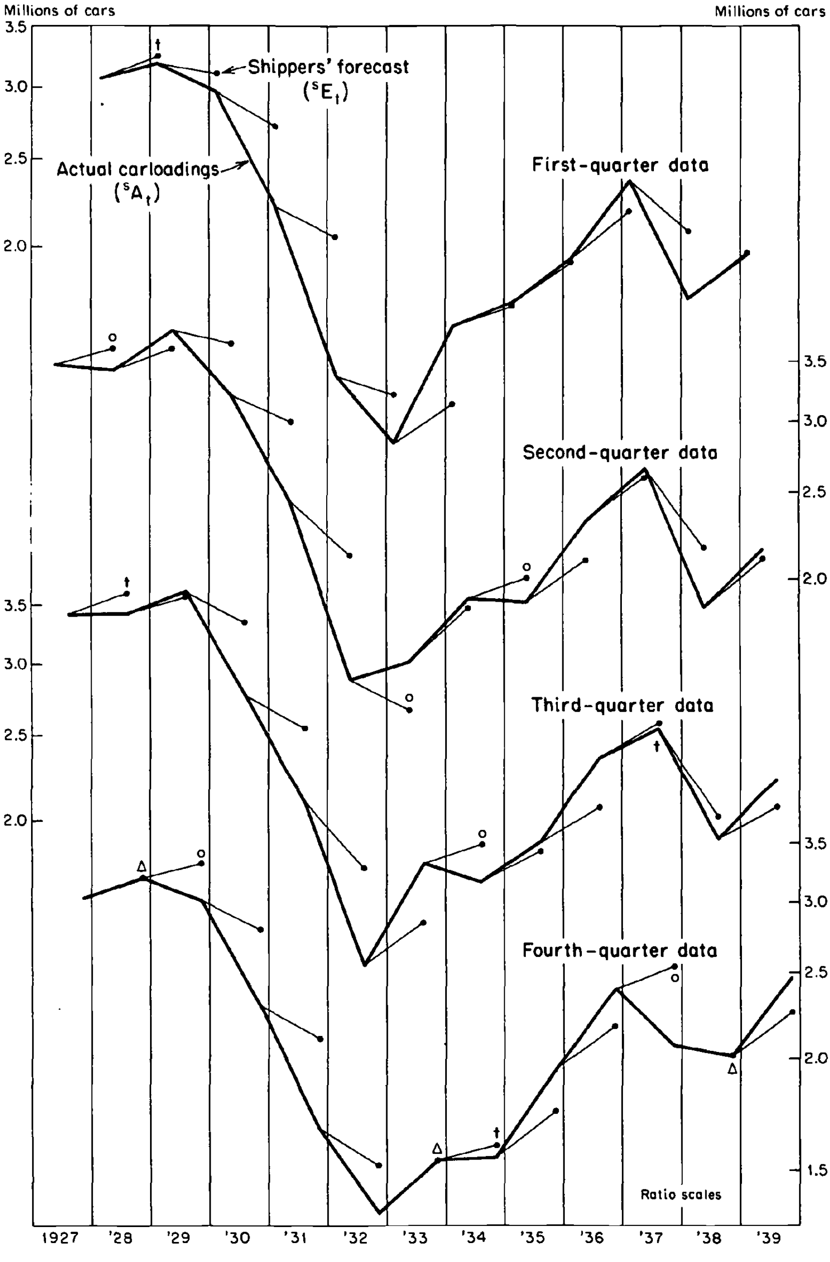
[9] This fact presumably explains the failure of the compilers of the survey to identify and correct the biases analyzed below. The *Proceedings* of the regional Shippers' Advisory Boards show great interest in a quarterly "accuracy check" matching the latest available actual figures (ordinarily two or three quarters back) against forecasts for the same date. But the check concentrates on *levels*, while it is analysis of *rates of change* that enables us to measure the biases.

[10] If we run the same correlations on data *without* seasonal adjustment, we get results somewhat more favorable to the forecasts. A simple correlation of A_t with A_{t-1} yields an r^2 of about 0.85; a joint regression of A_t on A_{t-1} and E_t yields an R^2 of about 0.89. The implied partial r^2 of A_t on E_t, taking account of A_{t-1} is about 0.24.

This result suggests that E_t does contain an element of valid allowance for seasonal fluctuations, although the root of the bias in the E's is lack of confidence in shippers' ability to allow for seasonality! But in this type of comparison, we are penalizing our naïve hypothesis for having a shape which embodies no seasonal allowance. If we started from A_{t-1} *and* an estimate of seasonally-to-be-expected change, there would probably again be no trace of net predictive value for E_t.

CHART 2

Actual and Forecast Four-Quarter Changes in Carloadings, All Manufactured Products, 1927–1939



The coherence of the four-quarter estimates is shown in Chart 2. Since we are interested in four-quarter changes, I drew a separate curve for each time of year. As in Chart 1, I linked the actual carloadings in a continuous curve, showing forecasts as points connected with the corresponding previous actual data by thin lines. In only 6 instances (marked on the chart by ○) does the thin line fail to move in the same direction as the actual data—that is, the forecast E_t/A_{t-4} fails to give the same direction of change as the actual A_t/A_{t-4}. Only in 5 (marked by †) does the estimate give the right direction but overstate the change. In 3 instances (marked by △) the estimate and outcome coincide.[11] In the other 33 instances, the forecast four-quarter change is right in direction but too small—too small, typically, by rather more than half.

The failures to point in the right direction, furthermore, are not only few but interestingly dated. Of the 6, 3 (at IV 1929, II 1933, and IV 1937) suggest the missing of major turns in activity.[12] As the facts on inventory accumulation indicate, such major turns involve major surprises for the business community. Thus the discrepancies do not conflict with the hypothesis that we are looking at reports rooted in the actual plans of business. On the contrary, what is really disconcerting is the failure of the forecast to *miss* the upturn in 1938, for which the special explanation may be that this was an extremely well-advertised revival, in view of the lively concern of the public with the government's antirecession policy. In addition, the fact that the upturn first registers as an actual four-quarter gain, in I 1939 shows that information had unusually good opportunity to be right.

CORRECTION FACTORS

Confronted with such a systematic bias, the natural response of the analyst who wants to forecast is to counter it by a systematic correction.[13] The logic of such a correction will be different if instead we aim to reconstruct an image of what businessmen thought would happen. But before

[11] For details, see Table A-2.

[12] Two of the remaining 3 (at III 1934 and III 1935) represent the missing of sharp interruptions of a major upswing. Note that the 3 errors of direction in the forecast that are linked with major turning-points come *after* turns (at III 1929, I 1933, and II 1937) in the seasonally adjusted actual data shown in Table A-1. In each case, the quarter of the error in direction is that in which the swing of business took on momentum after a start which might have been felt as a mere wobble.

[13] See the strictures of the Consultant Committee on Business Expectations on the failure of the Illinois study to make such adjustments, in *Reports of Federal Reserve Consultant Committees on Economic Statistics*, Joint Committee on the Economic Report, 1955, pp. 533-534. As the Committee pointed out, the desirability of a correction was recognized by Franco Modigliani, the director of the Illinois study which included Ferber's monograph. But Modigliani's tests of such adjustments applied them to the forecasts treated as one-quarter-change estimates (E_t/A_{t-1}) rather than as four-quarter estimates. See Franco Modigliani and O. H. Sauerlender, "Economic Expectations and Plans of Firms," *Short-Term Economic Forecasting*, pp. 283-286, and 308.

facing these difficulties, we should pause to see what correction factors the data yield.

Actual four-quarter changes are graphed as a scatter against raw shipper-forecast changes in Chart 3. Four points on the chart are left floating. The two marked D represent the two quarters (IV 1929 and IV 1937) when major downswings took on momentum; the two marked U represent the quarters (II 1933 and III 1938) when major upswings took on momentum. The slopes of the lines joining the remaining points to the center of gravity of the scatter may be seen as estimates from individual observations of the degree of understatement in four-quarter change forecasts. It is plain from the scatter that the estimates are averageable.

Regression analysis using all quarters except those marked D and U suggests that our best estimate of the actual change from a given E_t is given by the equation:

$$\text{Estimate of } {}_aY_t = {}_hY_t = 0.997+2.269\,({}_eY_t-1.026)$$

where ${}_aY_t$ is the actual four-quarter change (that is, A_t/A_{t-4}) and ${}_eY_t$ is the change indicated by the raw forecast (that is, E_t/A_{t-4}). The constant terms 0.997 and 1.026 introduce a correction for the over-optimism in level of the forecast change (which averages $+2.6$ per cent whereas actual change averaged -0.3 per cent); the multiplier 2.269 introduces a correction for the understatement of change.[14]

For the forty-two quarters used to fit the regression, the predictive value of this estimating equation is impressive. It yields an r^2 of about 0.89. Contrary to our finding for the raw forecasts of level, this correlation far exceeds that of comparable naïve-model hypotheses. The hypothesis that ${}_aY_t$ can be predicted from ${}_aY_{t-1}=A_{t-1}/A_{t-5}$ yields an r^2 of only 0.756. This naïve-model hypothesis cannot be perceptibly improved by bringing in also the previous value ${}_aY_{t-2}=A_{t-2}/A_{t-6}$; for the resulting R^2 is only 0.764. Thus the shippers' forecast shows a considerable superiority to naïve-model hypotheses in predicting four-quarter change, by the test of its gross predictive value.[15] Combining ${}_hY_t$ with ${}_aY_{t-1}$, gives an R^2 of 0.89—no better than the simple r^2 for ${}_hY_t$ alone. Thus the net predictive value

[14] This coefficient is the reciprocal of the regression of ${}_eY_t$ on ${}_aY_t$. I preferred this to the alternative regression (2.024) of ${}_aY_t$ on ${}_eY_t$ primarily to minimize deviations in the direction of presumed error, because the actual data should be less subject to error than the raw-forecast E's.

[15] If we were concerned with forecasting for its own sake rather than as a test of our ability to reconstitute a picture of expectations, the case for the shippers' forecast would be still stronger. For the actual shipments A_{t-1} cannot be measured with any precision till several weeks after the forecast E_t is available. A practical forecast of ${}_aY_t$ from data observable in advance, therefore, could use only ${}_hY_t$ and ${}_aY_{t-2}=A_{t-2}/A_{t-6}$. But $\bar{r}^2$ for ${}_aY_t$ on ${}_aY_{t-2}$ is only 0.45. And of course since ${}_aY_{t-1}$ shows no net predictive value when combined with ${}_hY_t$, the same is and must be true for ${}_aY_{t-2}$. So for practical purposes, the record suggests that the shippers' forecast is useful, and the available extrapolative data useless.

of the forecast, when we add it to extrapolative evidence, is to reduce unexplained variance from about 0.24 to about 0.11, with a partial r^2 of about 0.55. We must infer that the reconstituted forecast ratio ${}_hY_t$ contains valid evidence over and above what a simple extrapolation would yield.[16]

Turning to the formation of expectations, the greater part of the *gross* forecasting value of ${}_hY_t$ does seem to trace to its extrapolation content. We find an r^2 of 0.83 between ${}_eY_t$ (which of course must have the same correlation as ${}_hY_t$) and the previous actual change ${}_aY_{t-1}=A_{t-1}/A_{t-5}$. This can be raised to an R^2 of 0.86 by including ${}_aY_{t-2}=A_{t-2}/A_{t-6}$ as a second independent variable.[17] Since the extrapolation can explain more of the forecast than it can of the actual data, while the forecast has substantial

[16] My precautions of lopping off the suspect 1940-41 figures and omitting the four quarters most affected by major turns in activity turn out to have been needless for getting unbiased estimates of the degree of understatement and of the predictive power of the forecast. On four alternative standards of coverage, results are as follows:

Basis	*Excluding Four Major-Turn Quarters* 1928-39	*Excluding Four Major-Turn Quarters* 1928-41	*All Quarters* 1928-39	*All Quarters* 1928-41
Number of quarters	42	50	46	54
Understatement correction:				
$1/b_{ea}$	2.28	2.24	2.28	2.24
Simple r^2's:				
${}_ay_t$ on ${}_ey_t$	0.90	0.82	0.87	0.81
${}_ay_t$ on ${}_ay_{t-1}$	0.76	0.72	0.76	0.70
${}_ey_t$ on ${}_ay_{t-1}$	0.83	0.83	0.79	0.80
${}_ay_t$ on ${}_ay_{t-2}$	0.46	0.42	0.46	0.43
${}_ey_t$ on ${}_ay_{t-2}$	0.44	0.46	0.45	0.48
${}_ay_{t-1}$ on ${}_ay_{t-2}$	0.69	0.71	0.70	0.71
Multiple R^2's:				
${}_ay_t$ on ${}_ey_t$, ${}_ay_{t-1}$, ${}_ay_{t-2}$	0.90	0.83	0.88	0.82
${}_ay_t$ on ${}_ay_{t-1}$, ${}_ay_{t-2}$	0.77	0.74	0.76	0.74
${}_ey_t$ on ${}_ay_{t-1}$, ${}_ay_{t-2}$	0.86	0.85	0.81	0.81
Partial r^2:				
${}_ay_t$ on ${}_ey_t$, with ${}_ay_{t-1}$, ${}_ay_{t-2}$ constant	0.57	0.34	0.47	0.32

Regardless of coverage, the forecast four-quarter change shows stronger *gross* predictive value than the last two experienced changes (singly or in combination), and has a strong partial r^2 (while the gain from r^2_{ae} to $R^2_{ae\cdot a_{t-1},a_{t-2}}$ is so trifling as to yield insignificant partial correlations for the extrapolative series).

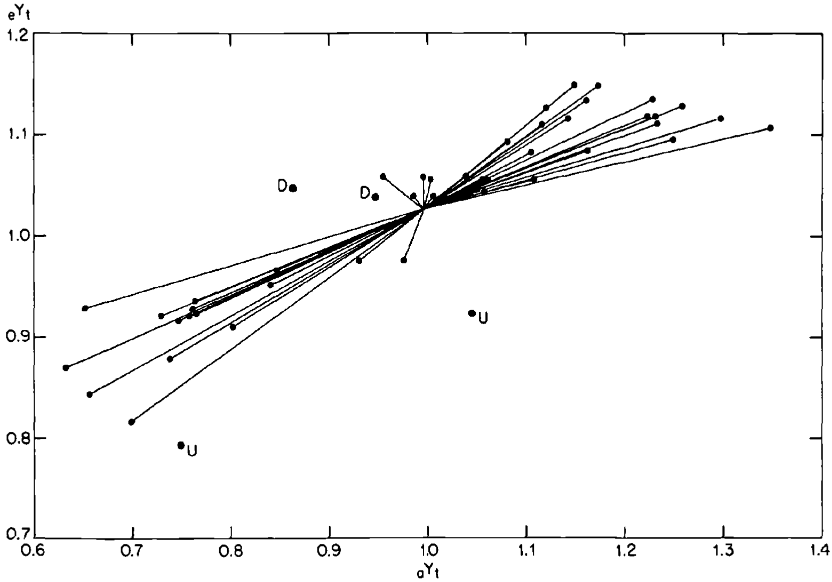
[17] Though ${}_aY_{t-2}$ makes only a modest net contribution to the prediction of the forecast $Y(r^2_{e_ta_{t-2}\cdot a_{t-1}}=0.17)$, the partial regressions look sensible. We obtain:

$$\begin{aligned} {}_ey_t &= 0.59({}_ay_{t-1})-0.15({}_ay_{t-2}) \\ &= 0.44({}_ay_{t-1})+0.15({}_ay_{t-1}-{}_ay_{t-2}) \end{aligned}$$

Remembering that the percentage change shown by ${}_eY_t$ has to be amplified by about 2.27 to correct for understatement, this is to be interpreted as saying that the forecast has as its basic element the change from $t-5$ to $t-1$, tempered by the recent rise or fall in the rate of change.

CHART 3

Four-Quarter Link Relatives of Actual and Shippers' Forecast Carloadings, All Manufactured Products, 1928–1939



net predictive value, we must infer that extrapolation injected a certain amount of error into the forecast—more than offset by nonextrapolative elements in the forecast.

If we included the four *D* and *U* quarters in the analysis, the apparent relation of actual to forecast four-quarter change would be weaker. On this basis, the r^2 for actual changes in carloadings on shippers' forecast changes would be only 0.87 instead of 0.90, and the partial r^2, taking account of the two previous changes ${}_aY_{t-1}$ and ${}_aY_{t-2}$ would be only 0.47 instead of 0.57. But this is as it should be: the hypothesis that we are looking at forecasts based on the actual plans of fallible businessmen *requires* that including these quarters should weaken the relationship. On the other hand, it *is* somewhat damaging to the hypothesis that including the *D* and *U* quarters changes the relation of the forecast to antecedent experience: the R^2 for the forecast ${}_eY_t$ on the previous actual changes ${}_aY_{t-1}$ and ${}_aY_{t-2}$ drops from 0.86 to 0.81.

INTERPRETATION OF UNDERSTATEMENT

While a correction for understatement along these lines is statistically plausible, is it economically and psychologically plausible? If the correction were only a small fraction, there would be no problem. Instead it is embarrassingly large. Suppose for example that a 20 per cent increase over the quarter $t-4$ is in prospect for the quarter t. Then the seasonally adjusted level at the time the forecast is framed (toward the end of quarter $t-1$) is likely to be perhaps 15 per cent above that of quarter $t-4$. How then can we explain the shippers saying that A_t will be only 8 per cent above A_{t-4}—i.e. putting their estimate ${}^sE_t$ (say) 7 per cent *below* the seasonally adjusted level ${}^sA_{t-1}$ which exists as they frame their forecast?

A number of interpretations have been suggested, notably:

1. Mixed in with four-quarter-change forecasts from one group of informants are one-quarter or two-quarter forecasts from another group.
2. Mixed in with four-quarter-change forecasts from one group of informants are "no-change" forecasts from another group who do not really mean what they say.
3. The four-quarter-change forecasts are scaled below the change informants actually expect out of "statistical conservatism."

Probably each interpretation has some validity, but the main weight falls upon the third.

Mixture of One-Quarter and Four-Quarter Forecasts. The first possible interpretation may be inferred from a suggestion by Modigliani and Sauerlender, though they would clearly never have offered it as the major explanation of the discrepancies in the shippers' forecast.[18] If for example one-quarter changes averaged one-fourth of the four-quarter changes that include them, and if half the informants substituted one-quarter forecasts, this would explain an understatement of actual change by three-eighths. A scattering of such responses is clearly possible, since survey procedures have never been standardized. Yet there are strong indications that the collectors of the survey and their informants do in fact aim to compare with the same quarter a year previous. The *National Forecast* bulletin, which shippers receive quarterly, refers in its title to a year ago, and from the beginning has printed its results in four columns—actual cars loaded a year ago (at $t-4$), cars to be loaded in quarter t, percentage increase (for industry groups estimating a rise), and percentage decrease (for those estimating a fall). Ferber's survey of the way data are procured suggests that all the various procedures used lead the informant to look at last year's figures and that none call upon him to look at figures for intervening quarters.[19]

[18] *Op. cit.*, p. 303: "Respondents are not really replying to the question as worded, but . . . (perhaps subconsciously) [to] a question" about change over a shorter period. Their suggestion is addressed specifically to discrepancies in the Dun and Bradstreet survey, where there seem to be ambiguities in the reference dates the informant is supposed to use. They put much the same stress as does the present paper on the strong emphasis placed by the shippers' survey on the previous-year reference point, which should reduce the frequency of short-period forecasts in the returns of individual informants.

[19] *Ibid.*, p. 17. The lack of standardization is of course the reason Ferber fails to reproduce any questionnaire forms.

Furthermore, an interesting piece of numerological evidence indicates that shippers do aim their forecasts to refer to four-quarter changes—the prevalence of rounded four-quarter-change percentages. Offhand, since we are supposedly looking at the ratio of a summation of estimated cars in quarter t to actual cars in quarter $t-4$ for a number of shippers, it would seem fantastically unlikely that we should often find such percentages for ${}_eY_t = E_t/A_{t-4}$ as 100.0 or 90.0. Yet in fact such round numbers are decidedly common in the printed figures. Many of the items for particular commodities in particular regions must not in fact be survey results, but "single-voice responses." By this I mean that some single spokesman is taking it upon himself either to substitute his judgment for that of his commodity group or at least to round the figures yielded by the survey. In the Alleghany district, where such responses have been relatively common, the roughly 760 entries of estimated change ${}_eY_t = E_t/A_{t-4}$ in 1928-39 include 128 which are multiples of 5.0 per cent.[20] If we may take it that the single-voice responses that crop up in print have much the same character as individual responses buried in the aggregates, it would seem clear that it is normal to relate the forecast to the same time last year as suggested by those who collect the figures. There does not seem to be any greater frequency of round-figure estimates for one-quarter changes than could arise by chance.[21] While these figures relate to only one district, and to a district where round-figure published entries may be unusually common, it apparently is not a district where understatement is unusually mild. If anything, preliminary analysis suggests more than average understatement in the Alleghany district. Thus inclusion of one-quarter-change

[20] Specifically:

	Per Cent	*Number*
Items of	100.0	44
Other multiples of	25.0	20
Total multiples of	25.0	64
Multiples (other than 50, 100, and 150 per cent) of	10.0	36
Total multiples of	10 or 25	100
Multiples (other than 25 and 75 per cent) of	5.0	28
Total multiples of	5.0	128

In addition, we find a few multiples of 33.3 per cent, and many of 2.5 per cent, 2.0 per cent, and 1.0 per cent. Also several commodities often show estimates diverging in a uniform direction from a round figure by an amount of 0.1 or 0.2 per cent—suggesting a single voice covering most of the industry, with a few informants filing separate returns. Thus the figure of 128 understates the number of round-figure responses by an amount that is hard to specify.

[21] This impression may be unreliable. The *National Forecast* is not published in a form to facilitate one-quarter comparisons; two numbers must be collated to match E_t with A_{t-1}. In any event, figures for A_{t-1} are incomplete by several weeks as each respondent frames his E_t, so the published totals for A_t would not be accurate sums of the estimates informants would use if they tried to estimate one-quarter changes.

estimates erroneously processed as four-quarter estimates does not seem to account for much of the understatement.

Mixture of Change and No-Change Forecasts. The second explanation would be that the published figures may be an averaging together of relatively realistic estimates of four-quarter change by some respondents with unrealistic estimates of no change submitted by or on behalf of other respondents.[22] An estimate of no change (that is, ${}_eY_t = E_t/A_{t-4} = 100.0$ per cent) would on its face mean, "I forecast that A_t will be the same as A_{t-4} within 1 or 2 per cent." Often, this is what it does mean. But a no-change estimate could also be a code message meaning, "Estimation for date t has to be on such a shaky basis that I refuse to forecast and enter last year's figure not because I think it will really be repeated but because my answer must be arbitrary." A postwar example of such a code message is the filing by the mine operators' association in the Ohio Valley district of no-change estimates in 1946 and in 1949 when there were strikes *in the quarter when the estimate was framed.* No-change estimates are surprisingly common. Some seem to be code messages of the type just described. Others are entered as a clerical routine in regional offices when data are not at hand for a real forecast, especially for commodities so unimportant in the district that there is no commodity chairman.

This second hypothesis was my favorite when I prepared the original draft of my paper. But I was able to devise a few tests, and the results suggest that it does not account for the bulk of the understatement. Scrutiny of the forty-four no-change entries for nonfarm commodities in 1928-39 in the Alleghany district shows that a large proportion come at stages when it seems likely that almost-no-change may have been the informant's real meaning; that is, they come between an estimate of increase and an estimate of decrease. Furthermore, for a group of nine commodities with no-change estimates in the Alleghany district in 1935-39, I tried replacing no-change figures with the average estimated change in the remaining series. This procedure, which should remove understatement resulting from no-change code messages, had remarkably little effect on the size of estimated changes.[23] I must conclude that this factor

[22] This hypothesis was drawn to my attention by Millard Hastay (see his comment at p. 571 of the committee report on general business expectations, *Reports of Federal Reserve Consultant Committees on Economic Statistics*, Joint Committee on the Economic Report, 1955). It develops that the same suggestion was made by Geoffrey Moore in correspondence and by Robert Ferber in a paper in the *Journal of the American Statistical Association*, September, 1953, pp. 385–413.

[23] For all nine industries, the average without regard to signs of the twenty forecast four-quarter changes in 1935-39 is 7.3 per cent. Calculating change to each quarter t only for those of the nine industries which *do not* estimate $E_t/A_{t-4} = 100.0$ per cent raises the average to 8.1 per cent. This is for a period including two major turns. If the two quarters (IV 1937 and III 1938) excluded from calculations in the text are excluded here, the average forecast change becomes 6.6 per cent for all nine industries, 7.6 per cent for those which do not estimate "no change" in the quarter in question. The selection of industries in which single-voice responses seem to be normal should make this a reasonable test of the quantitative importance of coded no-change estimates.

as well as the admixture of one-quarter-change estimates is incapable of explaining the bulk of the understatement.

Statistical Conservatism. We are left, then, with statistical conservatism, which may take any of several different forms.[24] The traffic manager may suspect the production and sales departments of the firm of furnishing exaggerated estimates of change. Or having framed estimates in line with theirs, he may tone them down before he submits them to the advisory board. (He may think that if he had the direction of change right, he will not lose credit for sagacity by understating the size of the four-quarter change. And if by any misfortune he turns out to be wrong about direction, he will look wiser if he has not said the change will be large.) Or the compilers in the office of the advisory board or commodity chairman may tone down estimates which look extreme to them.[25]

If the procedure of the survey was such that the informant always had the full benefit of the record of the year so far in deciding what figure to submit, statistical conservatism could scarcely yield regressive forecasts which show a change from quarter $t-4$ to quarter t smaller than has already taken place from quarter $t-4$ to quarter $t-1$. But apparently businessmen still rarely keep their records on a seasonally adjusted basis; even fewer did so in the interwar period. The whole same-time-last-year basis of comparison expresses a lack of confidence in the informant's ability to sort out seasonal from nonseasonal changes in the events of the last few months. If the informant consults his records for any quarter other than $t-4$, the likeliest figures to use for orientation will be either the recently completed ratio ${}_aY_{t-2}=A_{t-2}/A_{t-6}$ or the almost-completed ratio ${}_aY_{t-1}=A_{t-1}/A_{t-5}$, using a forecast for the results (A_{t-1}) of the quarter which is in process when the forecast ${}_eY_t=E_t/A_{t-4}$ must be framed. If, say, the ratio ${}_aY_{t-1}=A_{t-1}/A_{t-5}$ bids fair to be 115 per cent, it may seem conservative to put ${}_eY_t=E_t/A_{t-4}$ at 110 per cent.

We must choose among the three hypotheses if we wish to assert that the respondent at the back of the survey really has a carloading expectation in line with a coherent operating plan, an expectation somehow given a biased report in the survey. If we deny this proposition, there are two other possible interpretations of the data:

4. The traffic manager really expects much what is reported—for example, he really expected each quarter in 1930-32 to see the downswing reversed immediately—but has no coordination with the rest of his firm. (If the firm as a whole really expected an upturn in each of these quarters, it would have maintained employment and produced to inventory, which we know from the history of the period most firms did not.)

5. The traffic manager was really not talking about the plans of his

[24] A possibility also adumbrated by Modigliani and Sauerlender.

[25] Michael Lovell tells me he has found indications in one regional office of a systematic leveling down of individual responses which suggest drastic change.

firm, but merely "participating" in the activity of his regional advisory board by playing a numbers game. In this case, his figure was designed simply to fit into a pattern, which implies that it will be purely a figure, for which there is no source but extrapolation of recent carloading figures.

These two hypotheses have one crucial element in common. They imply that the traffic manager has no evidence to go on from other aspects of his firm's operation and works only from the record of carloadings—supplemented perhaps by evidence from outside the firm on general business conditions, of which he can scarcely be an expert analyst.

The present analysis of the predictive value and apparent genesis of forecasts is reasonably selective between these two families of hypotheses. Hypothesis 4 or 5 requires that extrapolative naïve-model hypotheses should match or better the performance of the shippers' forecast, whether raw or corrected for bias. Hypotheses 1, 2, and 3 require that the forecast (raw or corrected) should perform so well that we must infer the use of valid nonextrapolative evidence, and scrutiny of the four-quarter-change estimates has supported this view. The next step is to correct for understatement of change, treat the results *as if* they represented realistic operating intentions, and see whether they can outperform naïve hypotheses in "explaining" levels of shipments and one-quarter changes.

THE RECONSTITUTED H-PREDICTION OF LEVEL

Given our regression for four-quarter changes, it is simple to reconstitute an implied series of estimated levels of carloadings. For each quarter t, we have a raw forecast of four-quarter change ${}_eY_t = E_t/A_{t-4}$. We can transform this into a forecast purged of change understatement and level optimism by writing:

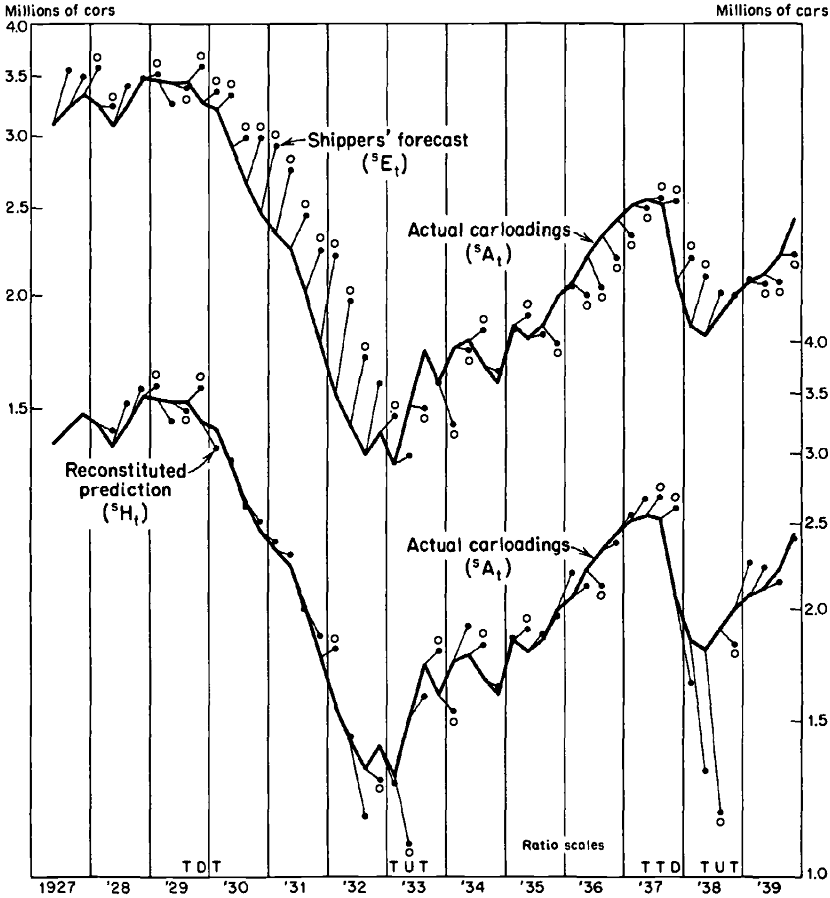
$${}_hY_t = 1.00 + 2.27\,({}_eY_t - 1.03).$$

If we use the symbol H_t for the implied expectation of the level of carloadings, we can simply write $H_t = ({}_hY_t \cdot A_{t-4})$, or with seasonal adjustment ${}^sH_t = ({}_hY_t \cdot {}^sA_{t-4})$. We can then graph the ${}^sH_t$'s against actual carloadings (Chart 4) on the same convention we used for the raw-forecast ${}^sE_t$'s in Chart 1. Against a solid curve of seasonally adjusted ${}^sA_t$'s, the seasonally adjusted ${}^sH_t$'s are shown as points, each connected by a thin line to the point representing ${}^sA_{t-1}$.[26] A glance at the chart shows that our

[26] An alternative procedure for deriving H-predictions would be to seek an understatement coefficient that would minimize squared deviations for levels of carloadings or for one-quarter changes, rather than for four-quarter changes. In correlation terms, what we minimize in the procedure used in the text is the sum of squares $({}_ay_t - B_e y_t)^2$ when ${}_ay$ and ${}_ey$ are deviations from the means of ${}_aY_t$ and ${}_eY_t$. To get the minimum squared deviation of levels or one-quarter changes, we would minimize a *weighted* sum of the squares of such terms. The weights are base-period shipments (A_{t-4}'s) for the estimate of levels, and ratios (A_{t-4}/A_{t-1}) for one-quarter changes. An experiment on the latter basis yields to three significant figures the same understatement coefficient we obtained from the unweighted sum, so that in the present case it probably matters little

CHART 4

Actual and Forecast Carloadings, All Manufactured Products, Quarterly, Seasonally Adjusted, 1927–1939



simple adjustment has shaken out almost all the nonsense that appeared in Chart 1. The levels shown by the *H*-predictions diverge much less from the actual carloadings. Into the bargain, the slopes of the thin lines agree most of the time with the slopes of corresponding segments of the actual carloadings curve.

A regression analysis of the reconstructed *H*-prediction in relation to the actual data is thoroughly compatible with the hypothesis that the *H*-prediction represents genuine expectations. On a seasonally-adjusted basis, for the forty-three quarters when it is reasonably likely that plans

which procedure we use. The logically simpler method of the text happens not to be at any statistical disadvantage.

could be fulfilled, there is an r^2 of 0.949 between the actual level ${}^sA_t$ and the reconstituted forecast ${}^sH_t$. This is slightly superior to the r^2 of 0.943 for ${}^sA_t$ on the previous actual level ${}^sA_{t-1}$ over the same forty-three quarters. True, both these coefficients can be bettered by a slightly more refined extrapolative hypothesis: ${}^sA_t$ has an R^2 of 0.956 over the forty-three quarters with ${}^sA_{t-1}$ and ${}^sA_{t-2}$ combined. But if we take a multiple correlation which combines these two pieces of extrapolative evidence with ${}^sH_t$, the R^2 for forty-three quarters goes up to 0.969, implying a partial r^2 of 0.30 for the H-prediction. This result squares very well with the hypothesis that the reconstituted forecast combines extrapolative evidence with valid nonextrapolative evidence in the minds of informants.[27]

This impression is strengthened if we exclude also the testimony of the eight quarters marked T on the chart—quarters so linked with major turning points that substantial surprises are likely (though not so highly probable as for the D and U quarters). For the remaining thirty-five quarters, the first naïve model (correlating ${}^sA_t$ with ${}^sA_{t-1}$) yields an r^2 of 0.931, and the second (correlating ${}^sA_t$ with a combination of ${}^sA_{t-1}$ and ${}^sA_{t-2}$) an R^2 of 0.947. Both correlations can be bettered by the simple correlation of ${}^sA_t$ with ${}^sH_t$, which yields an r^2 of 0.960. Furthermore, the inclusion of ${}^sH_t$ with the two previous actual figures raises the R^2 from 0.947 to 0.970, implying a partial r^2 of 0.45 for the H-prediction.[28]

As to the formation of expectations, the regression analysis shows the reconstituted forecast ${}^sH_t$ in a sensible relation to preceding experience. We get essentially the same relation of the forecast to preceding experience whether we do or do not exclude the quarters when intentions must or may have been frustrated.[29] On a forty-seven-quarter basis, we arrive at the regression equation:

$${}^sh_t = 1.01{}^sa_{t-1} + 0.65({}^sa_{t-1} - {}^sa_{t-2})$$

[27] For all forty-seven quarters (including the D and U quarters where our hypothesis requires the informants to be in error), the simple and partial correlations for the H prediction are lower; the partial r^2 is only about 0.18.

[28] As before, if our central interest were forecasting as such, we would have to rule out ${}^sA_{t-1}$ on the ground that it was not available as soon as ${}^sH_t$. The latest previous actual figure which could definitely be used (${}^sA_{t-2}$) has a much lower correlation with ${}^sA_t$ than does the unavailable ${}^sA_{t-1}$. If we use all forty-seven quarters (to take the basis least favorable to the H-prediction), a simple correlation of ${}^sA_t$ with ${}^sA_{t-2}$ yields an r^2 of only 0.83, as against r^2 of 0.91 for ${}^sH_t$ and an R^2 of 0.93 for both variables combined. Thus for practical forecasting, availability of ${}^sH_t$ would have been a great improvement. On the other hand, we used some hindsight in estimating ${}^sH_t$, because both the seasonal adjustment and the understatement coefficient rest on data for the entire period; a current estimate of ${}^sH_t$ would presumably have been inferior.

[29] Regression results are as follows:

Number of Quarters	*Joint Regression Equation*		*Alternative Form*	R^2
35	${}^sh_t = 1.54{}^sa_{t-1} - 0.58{}^sa_{t-2}$	=	$0.96{}^sa_{t-1} + 0.58({}^sa_{t-1} - {}^sa_{t-2})$	0.938
43	${}^sh_t = 1.60{}^sa_{t-1} - 0.62{}^sa_{t-2}$	=	$0.98{}^sa_{t-1} + 0.62({}^sa_{t-1} - {}^sa_{t-2})$	0.937
47	${}^sh_t = 1.66{}^sa_{t-1} - 0.65{}^sa_{t-2}$	=	$1.01{}^sa_{t-1} + 0.65({}^sa_{t-1} - {}^sa_{t-2})$	0.932

This implies that our putative "real expectation" (for which H_t is a synthetic substitute) is built up by starting with the last quarter's actual carloadings (on a seasonally adjusted basis), and adding about two-thirds as large an increment as occurred between quarter $t-2$ and quarter $t-1$. There is then presumably a further addition or subtraction for non-extrapolative indications, as indicated by the fact that the reconstructed forecast outperforms the extrapolative naïve models in the quarters when it appears that the outcome was likely to be close to the expectation.

The Shippers' Forecasts as One-Quarter Estimates

THE RECONSTITUTED *H*-PREDICTION OF CHANGE

It is demanding a great deal of the reconstituted *H*-prediction to ask it to predict one-quarter changes. Our basic supposition is that the shippers had reasonably well integrated operating plans, but that the signals they sent in through the shippers' forecast about their plans were garbled in transmission. The adjustment in deriving ${}_hY_t$ from ${}_eY_t=E_t/A_{t-4}$ may be looked at as a device for filtering out noise picked up in transmission and thus approximating the original signal. But it is scarcely likely that the optimism about level and the size-of-change understatement which constitute the noise were so uniform through time as we imply by using a single constant to correct for each.[30]

Inspection of Chart 4, however, shows that in fact the *H*-prediction gives a rather sensible picture of quarter-to-quarter changes. Notably, the long series of regressive one-quarter-change forecasts shown by the raw figures of Chart 1 for 1930-32 and 1935-37 is replaced by an almost continuous series of forecasts that match the actual direction of one-quarter change. Whereas the raw forecast gave the wrong direction 28 times out of 47 quarters in 1928-39, the reconstituted forecast gives the wrong direction only 14 times. Furthermore, the 14 disagreements include 4 (at IV 1929, II 1933, IV 1937, and III 1938—our *D* and *U* quarters) which are required by hypothesis, and 3 more (at IV 1932, III 1937, and IV 1938) which have a similar relation to the major turning points. Out of the 35 quarters (including IV 1932) not tagged with *D*, *U*, or *T* and excluded from some analyses on grounds that, near turns, plans could very likely not be executed, the *H*-prediction on a seasonally adjusted basis disagrees with

[30] I experimented to see whether ${}_aY_t=A_t/A_{t-4}$ could be more closely estimated by an equation that lets the understatement coefficient be a function of the date and of the size of the four-quarter change to be estimated. Results were negative. Consequently, the simple equation used may be taken as my best estimate of the way to adjust the raw forecast with allowance for smooth changes over time and over differences in size of forecast. But any attempt to allow for less continuous changes in the degree of understatement of change would have to rest on correlation of the shippers' series with outside data (for example, with orders), which I have not attempted.

the actual direction of one-quarter change 7 times, compared with 25 times for the raw forecast.

A closer look reveals that almost all the disagreements in direction of one-quarter change are of a single type. In only 2 (in I 1932 and III 1936) does the H-prediction forecast a turn which fails to happen. In the other 12 the H-prediction forecasts a continuation of the previous direction of change while the actual data exhibit a reversal of direction. Of the 15 actual changes of direction in the seasonally adjusted figures, only 4 (at III 1928, I 1933, I 1935, and III 1935) were picked up by the H-prediction. Thus if this reconstitution is correct, it says that almost without exception the shippers expected continuation of the recent direction of movement and were surprised by turning points.[31]

Our chief interest must be in the one-quarter-change forecasts with seasonal adjustment, because this adjustment gives more scope for inquiries into extrapolative patterns of forecasting. But since the seasonal adjustment unavoidably brings in an arbitrary element, it is worth pausing to look at the relation of one-quarter changes without seasonal adjustment.

Without Seasonal Adjustment. On an unadjusted basis for 46 quarters[32] the series of actual changes (denoted by ${}_aX_t=(A_t/A_{t-1})$ shows 22 changes of direction between II 1928 and IV 1939, of which no less than 15 are picked up by the H-prediction ${}_hX_t=(H_t/A_{t-1})$, X being the one-quarter equivalent of Y. Besides missing 7 turns, the H-prediction calls for turns which did not happen in 7 of the 24 quarters when the direction of quarter-to-quarter change continued.

For the 34 quarters when it seems reasonably likely that expectations could be fulfilled, the correlation of one-quarter actual and H-predicted changes is fairly high ($r^2=0.72$). This is much better than we can do on the naïve-model hypothesis that ${}_aX_t$ can be explained by the year-previous change ${}_aX_{t-4}=A_{t-4}/A_{t-5}$; for this yields an r^2 of only 0.45. An alternative naïve-model hypothesis would be that the actual change ${}_aX_t$ can be explained by the seasonally-to-be-expected change ${}_sX_t=S_t/S_{t-1}$; this yields an r^2 of 0.56. Thus the gross predictive value of the H-prediction for one-quarter change is appreciably better than that of either naïve hypothesis. Furthermore, combining the seasonally-to-be-expected and H-predicted

[31] In the original version of this paper, I was inclined to view the shippers as missing major turns but picking up minor ones. This impression seems to go back to the roughness of my original seasonal adjustment. In view of Ruth Mack's finding that the mechanism of "sub-cycles" seems to be a reversal of the inventory band wagon (an event one would naturally interpret as surprising), it is much more reasonable that expectations should miss minor as well as major turns. (See Mrs. Mack's paper in *American Economic Review*, Supplement, May 1957, pp. 161-174).

[32] We lose one quarter as against the previous basis of calculations because we need to compare actual changes with previous-year changes at the same season (that is, with ${}_aX_{t-4}=A_{t-4}/A_{t-5}$); and the lack of a reliable A_t for quarter I 1927 means that our first estimate of ${}_aX_{t-4}$ applies to quarter III 1928.

change in a joint regression for the actual change gives an R^2 of 0.76. The gain over the simple correlation for the seasonally-to-be-expected change is large enough to give a partial r^2 of about 0.44 for the H-predicted change.

The H-predicted change shows a strong relation to the seasonally-to-be-expected change—as of course it must in order to be a good predictor of actual change without seasonal adjustment in our thirty-four quarters. The correlation of ${}_hX_t$ with ${}_sX_t$ yields an r^2 of 0.55. In addition, the H-predicted change shows a significant element of extrapolation from a year previous. If we take a joint regression for ${}_hX_t$ on ${}_sX_t$ and ${}_aX_{t-4}$ it yields an R^2 of 0.64, indicating a partial r^2 for ${}_aX_{t-4}$ of about 0.21. That is, there are some signs that *nonseasonal* change a year previous helps shape the forecast, in addition to seasonal allowances. Since ${}_aX_{t-4}$ has no net predictive value for ${}_aX_t$ when seasonality is taken into account,[33] this element in the forecast can only be a source of error. If therefore the H-predicted change ${}_hX_t$ is more highly correlated with actual change ${}_aX_t$ than is the seasonally-to-be-expected change ${}_sX_t$, it can only be because ${}_hX_t$ includes valid evidence on nonseasonal changes in prospect.

This view is confirmed by the fact that the predictive value of the H-prediction falls (while that of the seasonally-to-be-expected change does not) as we bring into our calculations the quarters when expectations were less likely to be fulfilled. If we recalculate for forty-two quarters (still excluding the four quarters of most drastic change, denoted by D and U), the r^2 for ${}_aX_t$ on ${}_hX_t$ drops to 0.60, while the r^2 for ${}_aX_t$ on ${}_sX_t$ stands almost unaffected at 0.54. If we go all the way to forty-six quarters, the r^2 for ${}_hX_t$ drops to 0.34—now markedly below that for ${}_sX_t$, which is still substantially the same ($r^2=0.56$).

Finally does the H-predicted change continue to conform to the actual at the appropriate points (i.e. for quarters on our list of thirty-four) if we make separate comparisons for each time of year? This test denies the H-prediction the benefit of knowing what time of year it is, as the correlation rests on *divergence* from the seasonal pattern in the actual and estimated changes. Since our thirty-four quarters are now split into four groups, individual statistical results from the four calculations rest on too few observations to carry any statistical weight. But the uniformity of

[33] The correlation of ${}_aX_t=A_t/A_{t-1}$ with ${}_sX_t=S_t/S_{t-1}$ and the previous-year change ${}_aX_{t-4}=A_{t-4}/A_{t-5}$ yields an R^2 of only 0.587, compared with an r^2 for ${}_sX_t$ alone of 0.562 over the thirty-four quarters.

This result should not surprise us. If the seasonal adjustment is unbiased, the residue of previous-year change after allowing for seasonality would exhibit a correlation with the current change only if the series exhibited either long runs of seasonally adjusted change in one direction or cycles close to a year in length (five or three quarters). The present series has neither characteristic; so our expectation is that the systematic element in the relation of ${}_aX_t$ to ${}_aX_{t-4}$ will all be incorporated in the seasonal adjustment.

results from the four tests is entitled to be taken seriously. For each of the four times of year:[34]

1. Actual change has a positive correlation with H-predicted change.
2. Correlation of actual change with previous-year change, though positive, is much smaller.
3. In a joint regression of actual on previous-year and H-predicted change, the latter accounts for the bulk of the variance "explained."

With Seasonal Adjustment. Analysis of seasonally adjusted data has the advantage that it makes the changes in recent quarters most comparable with current change. Thus it lends itself to a search for extrapolative influences on forecasts.

For this analysis, in addition to the current actual and H-predicted changes:

$$
\begin{aligned}
{}^s_aX_t &= {}^sA_t/{}^sA_{t-1} \\
{}^s_hX_t &= {}^sH_t/{}^sA_{t-1}
\end{aligned}
$$

we can represent recent history by:

$$
\begin{aligned}
{}^s_aX_{t-1} &= {}^sA_{t-1}/{}^sA_{t-2} \\
{}^s_hX_{t-2} &= {}^sA_{t-2}/{}^sA_{t-3} \\
{}^s_aX_{t-3} &= {}^sA_{t-3}/{}^sA_{t-4} \\
{}^s_aX_{t-4} &= {}^sA_{t-4}/{}^sA_{t-5}
\end{aligned}
$$

For the thirty-four quarters when intentions are most likely to have been carried out, an extrapolative estimate of the actual change ${}^s_aX_t$ from all four pieces of recent experience yields an R^2 of 0.35.[35] This is weaker than the

[34] The seasonally-to-be-expected change does not figure in the calculations because in comparisons for a single time of year it varies only with its trend. For the two remaining predictive variables, and excluding the eight T quarters and four D and U quarters, the relevant correlations are as follows:

	QUARTERS RELATED			
	I with *IV*	*II* with *I*	*III* with *II*	*IV* with *III*
${}_aX_t$ on ${}_hX_t$: r^2	0.34	0.21	0.53	0.78
${}_aX_t$ on ${}_aX_t$: r^2	.03	.02	.11	.40
${}_aX_t$ on ${}_hX_{t-4}$ and ${}_aX_{t-4}$: R^2	.34	.25	.54	.84
${}_hX_t$ on ${}_aX_{t-4}$: r^2	.06	.34	.34	.74

Compare the first three lines with the negative correlations obtained for raw forecasts at three of the four times of year by Ferber (p. 77). And in the last line, the four time-of-year calculations agree also in finding a positive correlation between ${}_hX_t$ and the previous-year change ${}_aX_{t-4}$, confirming the impression that the previous year's events enter (irrationally) into forecasts. Except for changes from the third to the fourth quarter, where ${}_aX_{t-4}$ happens to have a fairly strong correlation with ${}_aX_t$, this influence on the prediction ${}_hX_t$ must be a source of error (or at best of random differences).

[35] This could just as well be described as an estimate based on the last three pieces of experience, excluding ${}_aX_{t-4}$, for the multiple correlation is just the same whether we do or do not introduce this variable. This absence of predictive value for the previous-year change, as we saw in footnote 34, indicates the success of our seasonal adjustment.

r^2 of 0.44 which we find when we correlate ${}^{s}_{a}X_t$ with ${}^{s}_{h}X_t$. Furthermore, a compound prediction using the H-predicted change together with all the extrapolative elements yields a considerably improved correlation: $R^2=0.56$. The margin by which this exceeds the R^2 obtained on a purely extrapolative basis leaves a partial r^2 for ${}^{s}_{h}X_t$ of 0.33. Thus it is plain that ${}^{s}_{h}X_t$ has net as well as gross predictive value.[36]

The relation of the prediction to previous experience seems to show a fairly reasonable pattern. A multiple regression of ${}^{s}_{h}X_t$ on the four elements of recent experience yields an R^2 of 0.39. The greater part of the predictive value of recent experience for the reconstituted forecast seems to spring from the most recent history: for ${}^{s}_{h}X_t$ on ${}^{s}_{a}X_{t-1}={}^{s}A_{t-1}/{}^{s}A_{t-2}$ alone, the $r^2=0.32$.[37]

When we take in quarters when expectations were less likely to be fulfilled, the admixture of surprises pulls the forecasting correlation down rapidly. For forty-two quarters, though an extrapolative estimate still produces an R^2 of 0.37, the simple correlation of actual on H-predicted change is reduced to an r^2 of 0.35, and the partial r^2 falls to 0.22. On a forty-six-quarter basis, the extrapolative estimate is much weaker ($R^2=0.18$), and the simple correlation ($r^2=0.09$) and partial r^2 (0.01) for ${}^{s}_{h}X_t$ become negligible. On the other hand, the apparent relation of H-prediction to antecedent experience remains much the same.[38]

FORECASTS AND SURPRISES

How seriously can we take the H-predicted change as a measure of the specific changes at specific times? The fact that for our thirty-four quarters the r^2 for ${}^{s}_{a}X_t$ on ${}^{s}_{h}X_t$ is rather modest (0.44) might suggest either that the original plans were loose or that much random noise remained in the signal even after our rectification. But the correlation itself is inconclusive; once more we must ask whether the deviations as well as the similarities have a story to tell.

Actual one-quarter changes, seasonally adjusted, are graphed as a time series in the upper curve of Chart 5. The curve below shows the H-pre-

[36] As usual, we could make a better showing for the H-prediction if our central concern were forecasting with data available as soon as the shippers' forecast becomes available, ruling out A_{t-1} and hence ${}^{s}_{a}X_{t-1}$. A forecast of ${}^{s}X_t$ from the other more remote elements of experience yields an R^2 of only 0.09 compared with the r^2 of 0.44 from ${}^{s}_{h}X_t$ alone. Thus the forecast would at the very least be useful as a way of mobilizing evidence on ${}^{s}_{a}X_{t-1}={}^{s}A_{t-1}/{}^{s}A_{t-2}$ before it would ordinarily be available.

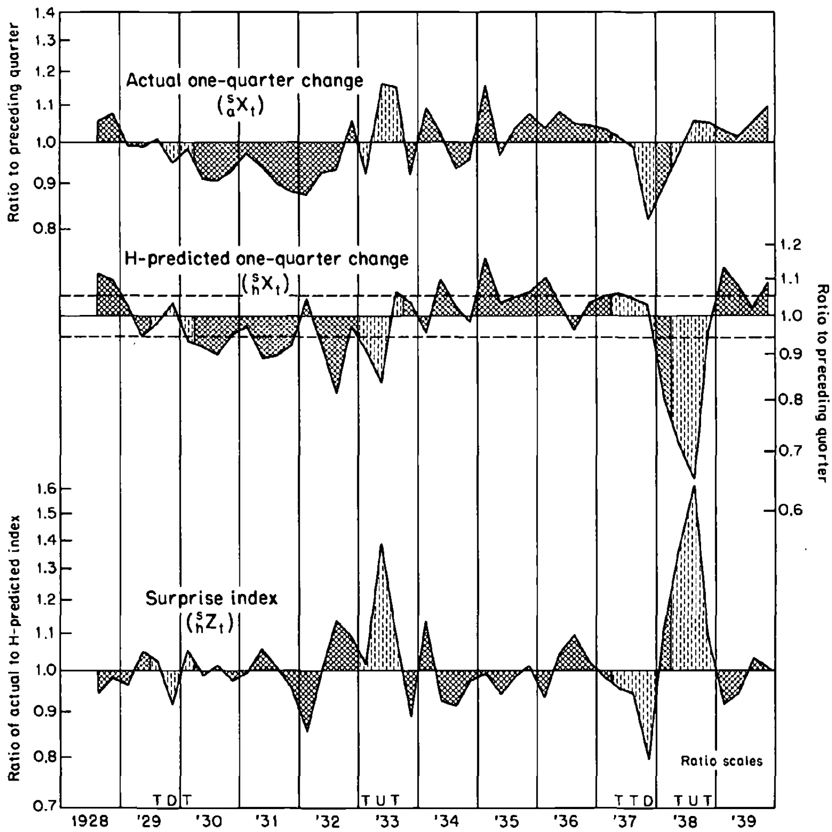
This comparison, however, is biased slightly in favor of the H-prediction by its use of two elements of hindsight: both the seasonal adjustment and the change–understatement coefficient are estimated from data for the entire period 1928-39.

[37] By some fluke, the calculations show no net predictive value for the second-most-recent item of experience, ${}^{s}_{a}X_{t-2}$.

[38] For the prediction ${}^{s}_{h}X_t$ on the most-recent-experience item ${}^{s}_{a}X_{t-1}$, r^2 over forty-six quarters is 0.26—slightly less than for thirty-four quarters. But R^2 using all four items of experience goes up to 0.41. The year-previous change ${}^{s}X_{t-4}$ shows a positive regression throughout, but a negligible partial correlation.

CHART 5

Carloadings of All Manufactured Products, Seasonally Adjusted Levels, Actual and Predicted, 1927–1941

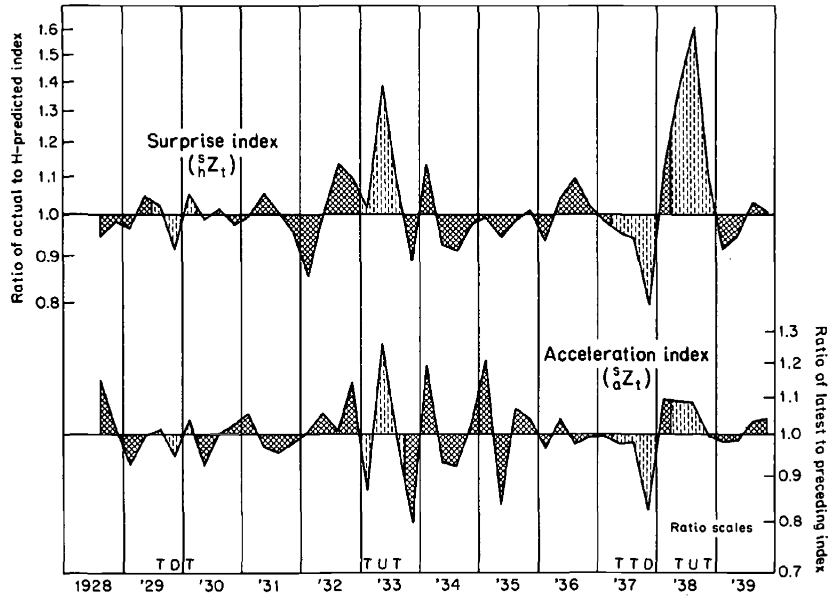


dicted changes. For our best thirty-four quarters (dark-shaded areas) the general family resemblance on which the correlation rests is clearly visible; so is the appropriate disagreement around the main turns (light-shaded areas). But for present purposes, the main interest attaches to the bottom curve, which traces the ratio of actual to expected one-quarter changes ${}^{s}_{h}Z_t = {}^{s}_{a}X_t / {}^{s}_{h}X_t$. This may be read as an index of surprise—upward-pointing teeth on the curve showing quarter-to-quarter changes more favorable than our index says was expected (agreeable surprises), and downward-pointing teeth less favorable (disagreeable surprises). The surprises registered at the four main turns are appropriate on the hypothesis that we have a valid index of expected changes.[39] But whether the wobble during

[39] However the allegedly expected adverse changes in 1938 (and the apparent disagreeable surprise) are unplausibly large. As with forecast four-quarter changes, the

CHART 6

Surprise Index and Acceleration Index, Quarterly, 1928–1939



the thirty-four best quarters (dark-shaded parts of the chart) is appropriate, we cannot say without further examination.

By the same logic which makes it appropriate for the *H*-prediction to miss major turns of activity, the index of surprise should be related to the *acceleration* of seasonally adjusted actual carloadings (that is, to an index ${}^s_aZ_t = {}^s_aX_t / {}^s_aX_{t-1}$). This is indeed the case, as may be seen from Chart 6. Here the top curve (carried forward from Chart 5) is our index of surprise $({}^s_hZ_t = {}^s_aX_t / {}^s_hX_t)$, the lower curve the index of acceleration. The relation of surprise to acceleration at the major turns is shown by the parallel saw-teeth in the dotted parts of the curves. Besides, there is a marked family resemblance between the parts of the two curves (dark-shaded areas) which report on our best thirty-four quarters. Of the 6 sharp points of disagreeable surprise (at I 1932, IV 1933, III 1934, II 1935, I 1936, and I 1939), only 1 (at I 1932) lacks a counterpart on the acceleration curve. The 5 peaks of agreeable surprise (at II 1929, III 1932, I 1934, and III 1939) do not fare so well: only 2 (at I 1934 and III 1939) have definite counterparts, while the highest rate of acceleration on the chart (at I 1935) fails to induce agreeable surprise. Thus the relation between surprises and acceleration is one of the weaker ones in the complex we are investigating,

upturn of 1938 was unusually well advertised and was in fact the only one of the four major turns *not* missed by the four-quarter-change estimates. Perhaps here the correction for understatement of four-quarter changes was overdone.

yet apparently significant: over thirty-four quarters $r^2=0.25$, over forty-six quarters $r^2=0.29$. Broadly speaking, we may say that of the variance in the one-quarter forecast ${}^{s}_{h}X_t$ within the best thirty-four quarters, 44 per cent is accounted for by valid forecasting of actual change and about a quarter of the remainder by identifiable failures to register forces accelerating or decelerating the actual carloadings. Thus on the hypothesis that the original signals registered coherent actual expectations, some 42 per cent of the variance in our reconstituted one-quarter forecasts must be attributed to noise picked up in the process of coding and decoding the message.

Such a result is scarcely surprising given the degree of arbitrariness in the way the figures were processed. It implies a standard error for *H*-predicted one-quarter changes of about 5.4 per cent. A zone of this width around unity is marked off on Chart 5. Taking one standard error as the margin beyond which an *H*-prediction probably registers an actual expectation that carloadings will move in the indicated direction, we may classify our *H*-predictions as follows:

	Probably Registering Expectation of Increase	*Doubtful*	*Probably Registering Expectation of Decrease*
1928	II, IV		
1929		I[a], III[b], IV[a]	II
1930		IV	I, II, III
1931		I, II	III, IV
1932		I[a], IV[a]	II, III
1933	III[b]	IV[a]	I, II[a]
1934	II	I[a], III[a], IV	
1935	I, IV	II[a], III	
1936	I	I[b], III[a], IV	
1937	II	I, III[a], IV[a]	
1938		IV[a]	I, II, III[a]
1939	I, II, IV	III[b]	

[a] Quarters where actual change was in the opposite direction from *H*-predicted change.
[b] Quarters where a small change was indicated but a large change in the predicted direction eventuated.
For specific figures, see Table A-2.

It is plain that a large proportion of the most interesting quarters must be classified as doubtful. On the other hand, some generalizations at least of a negative character can be offered. From the beginning of 1929 till mid-1933, there was not a single quarter (unless we count I 1932, with an *H*-predicted increase of 4.3 per cent) when expansion was probably expected. Similarly, from mid-1933 until early 1938, there was not a single quarter (unless we count III 1936, with an *H*-predicted drop of 3.7 per cent) when contraction was probably expected. On the whole, then, expectations appear to have reinforced rather than braked the major swings of business. Hesitation in 1929 and 1937 may have facilitated the downturns, but the two upturns seem to have happened despite strong expectations to the contrary.

Further Uses of the Shippers' Forecasts

From this examination, it appears likely that by simple adjustments to filter out bias we can transform the shippers' forecast into a workable source of data on what businessmen expected about the physical volume operations, and thus can go a long way toward rescuing expectational interpretations of the past from the limbo of the unobservable. As measures of both four-quarter changes and future level, the reconstituted forecast behaves just as it should if it represents actual expectations. As a measure of one-quarter change, it shows some weaknesses, inevitably impaired by the noise which the adjustment procedure fails to remove. But then much of the time the most skilled business cycle analysts are in some doubt about which way the economy is currently moving.

Even as they stand, the data afford a testing ground for some hypotheses about fluctuations. In particular, they can test the hypothesis that changes of expectations trigger major turning points in business—it flunks the test disastrously. Much more can be done by dealing with component series. Reweighting the components by value added instead of shipping-space requirements is likely to yield a more revealing aggregate. Furthermore, collation of these data with evidence on orders may cast a good deal of light on the relationship of orders to business operating decisions.

The analysis of component series will also provide strong tests for hypotheses on the formation of expectations. For example, we can test how much expectations in a given industry are shaped by the general state of business, how much by the industry's own experience. And comparison of postwar and interwar data can give clues to the stability of estimation patterns.

Finally, a good deal of data from which expectations can be reconstructed seems to exist, but it is probably fragmentary. However, the shippers' forecast may provide a framework by which the other series can be calibrated. And the apparent coherence of the shippers' forecast should encourage us to search for other data and to develop theories that can illuminate the data and be tested by them.

APPENDIX

SYMBOLS USED AND THEIR DERIVATIONS

Symbols Used in Equations

A indicates actual carloadings
a indicates deviations from mean of actual carloadings
a as a subscript indicates the symbol refers to actual carloadings
E indicates expected carloadings (shippers' forecast)

e as a subscript indicates the symbol refers to expected carloadings

F indicates the Federal Reserve Board index of manufacturing production

H indicates reconstituted prediction (corrected for bias)

h indicates a deviation from mean of the reconstituted prediction

h as a subscript indicates a symbol refers to the reconstituted prediction

S indicates the seasonal adjustment coefficient

s as a superscript indicates that a symbol has been seasonally adjusted

s as a subscript indicates that a symbol refers to the seasonal adjustment

t, $t-1$, $t-4$, etc., as subscripts indicate the quarter to which the figure refers (current quarter, previous quarter, four quarters or a year previous, etc.)

X indicates one-quarter change

Y indicates four-quarter change

y indicates deviation from mean of four-quarter change

Z indicates acceleration of change

Their Derivations and Examples

A_t and E_t are the basic data, transcribed from Ferber

${}^sA_t$ indicates actual carloadings in the current quarter, seasonally adjusted

${}^sE_t$ indicates expected carloadings in the current quarter, seasonally adjusted

${}_aY_t = A_t/A_{t-4}$ = actual four-quarter change

${}_eY_t = E_t/A_{t-4}$ = expected four-quarter change

${}_hY_t$ = best estimate of ${}_aY_t$

$H_t = {}_hY_t \cdot A_{t-4}$ = implied expectation of level of actual carloadings for a given quarter

${}^sH_t = {}^s_hY_t \cdot {}^sA_{t-4}$ = the same, seasonally adjusted

${}_sX_t = S_t/S_{t-4}$ = the seasonally to be expected change

${}_aX_t = A_t/A_{t-1}$

${}_hX_t = H_t/A_{t-1}$

${}^s_aZ_t = {}^s_aX_t/{}^s_aX_{t-1}$

${}^s_hZ_t = {}^s_aX_t/{}^s_hX_t$

Indicators in Charts and Tables

○ indicates forecast in the wrong direction

† indicates a forecast in the right direction but an overestimate

△ indicates the forecast and outcome coincide

D indicates a quarter in which a major downswing took on momentum

U indicates a quarter in which a major upswing took on momentum

T indicates a quarter (other than a D or U quarter) containing or just following a major turning point

TABLE A-1

Actual and Estimated Carloadings, All Manufactured Products, Seasonal Adjustment Coefficient, and Index of Manufacturing Production, 1927-1939
(*carloadings in millions of cars*)

YEAR AND QUARTER	NO SEASONAL ADJUSTMENT: *Actual Car-loadings* (A_t)	*Shippers' Forecast* (E_t)	*Recon-stituted Pre-diction* (H_t)	WITH SEASONAL ADJUSTMENT: *Actual Car-loadings* (${}^sA_t$)	*Shippers' Forecast* (${}^sE_t$)	*Recon-stituted Pre-diction* (${}^sH_t$)	SEASONAL COEF-FICIENT (${}^sS_t$)	MANU-FACTURING PRODUCTION, SEASONALLY ADJUSTED (${}^sF_t$)
1927:								
II	3.47	—	—	3.09	—	—	1.12	51
III	3.41	3.77	—	3.21	3.55	—	1.06	50
IV	3.01	3.15	—	3.33	3.49	—	0.90	48
1928:								
I	3.06	3.27	—	3.24	3.57	—	0.92	50
II	3.42	3.61	3.58	3.07	3.24	3.19	1.12	51
III	3.42	3.60	3.64	3.24	3.41	3.42	1.06	53
IV	3.18	3.18	3.20	3.48	3.48	3.55	0.91	56
1929:								
I	3.18	3.24	3.28	3.46	3.52	3.58	0.92	57
II	3.79	3.61	3.04	3.43	3.26	3.27	1.11	59
T III	3.62	3.57	3.55	3.44	3.40	3.36	1.05	60
D IV	3.01	3.30	3.25	3.26	3.58	3.56	0.92	55
1930:								
T I	2.96	3.10	2.80	3.21	3.36	3.05	0.92	52
II	3.21	3.66	3.26	2.92	3.33	2.95	1.10	50
III	2.77	3.34	2.76	2.65	2.99	2.62	1.05	45
IV	2.29	2.79	2.32	2.46	2.99	2.52	0.93	42
1931:								
I	2.21	2.71	2.22	2.34	2.93	2.39	0.92	42
II	2.45	3.00	2.32	2.25	2.75	2.31	1.09	42
III	2.10	2.55	2.10	2.02	2.45	2.01	1.04	38
IV	1.67	2.11	1.74	1.77	2.24	1.87	0.94	34
1932:								
I	1.44	2.05	1.71	1.55	2.21	1.81	0.93	33
II	1.55	2.13	1.58	1.43	1.97	1.44	1.08	29
III	1.38	1.77	1.23	1.33	1.71	1.17	1.04	28
IV	1.34	1.52	1.23	1.41	1.60	1.29	0.95	30
1933:								
T I	1.21	1.37	1.19	1.30	1.47	1.28	0.93	29
U II	1.62	1.43	1.18	1.51	1.33	1.09	1.07	35
T III	1.79	1.54	1.71	1.74	1.50	1.60	1.02	43
IV	1.54	1.54	1.71	1.60	1.60	1.80	0.97	36
1934:								
I	1.63	1.34	1.43	1.75	1.44	1.54	0.93	39
II	1.90	1.86	2.06	1.78	1.74	1.92	1.07	42
III	1.71	1.88	1.88	1.67	1.83	1.83	1.02	37
IV	1.55	1.60	1.58	1.60	1.65	1.64	0.97	38
1935:								
I	1.73	1.72	1.73	1.85	1.84	1.86	0.94	44
II	1.89	2.01	2.03	1.79	1.90	1.90	1.06	44
III	1.89	1.85	1.92	1.85	1.81	1.88	1.02	46
IV	1.95	1.75	1.90	1.99	1.77	1.97	0.98	50

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TABLE A-1, *continued*

YEAR AND QUARTER	NO SEASONAL ADJUSTMENT: *Actual Carloadings* (A_t)	NO SEASONAL ADJUSTMENT: *Shippers' Forecast* (E_t)	NO SEASONAL ADJUSTMENT: *Reconstituted Prediction* (H_t)	WITH SEASONAL ADJUSTMENT: *Actual Carloadings* (^sA_t)	WITH SEASONAL ADJUSTMENT: *Shippers' Forecast* (^sE_t)	WITH SEASONAL ADJUSTMENT: *Reconstituted Prediction* (^sH_t)	SEASONAL COEFFICIENT (^sS_t)	MANUFACTURING PRODUCTION, SEASONALLY ADJUSTED (^sF_t)
1936:								
I	1.93	1.92	2.05	2.06	2.05	2.20	0.94	49
II	2.33	2.10	2.25	2.22	2.00	2.13	1.05	53
III	2.36	2.07	2.18	2.33	2.04	2.13	1.02	57
IV	2.40	2.18	2.35	2.43	2.20	2.38	0.99	60
1937:								
I	2.37	2.19	2.40	2.52	2.33	2.56	0.94	63
T II	2.66	2.60	2.70	2.55	2.50	2.67	1.04	64
T III	2.55	2.58	2.71	2.53	2.56	2.68	1.01	63
D IV	2.07	2.54	2.56	2.07	2.54	2.60	1.00	50
1938:								
I	1.75	2.08	1.57	1.85	2.20	1.66	0.94	43
T II	1.86	2.17	1.39	1.80	2.10	1.32	1.03	42
U III	1.91	2.02	1.19	1.90	2.01	1.18	1.00	47
T IV	2.02	2.02	1.83	2.00	2.00	1.81	1.01	52
1939:								
I	1.96	1.97	2.14	2.07	2.08	2.26	0.95	53
II	2.16	2.11	2.31	2.11	2.06	2.23	1.03	53
III	2.22	2.07	2.15	2.22	2.07	2.15	1.00	57
IV	2.47	2.26	2.44	2.43	2.22	2.41	1.02	45

For the meaning of the symbols used, see the list in this appendix.

Source: *Cols.* A_t and E_t—Robert Ferber, *The Railroad Shippers' Forecasts*, University of Illinois Press, 1953, p. 138. *Col.* H_t—From correlations described in the text. *Col.* S_t—Fitted by the author to actual carloadings for 1947-51 by ratios to moving average. *Col.* F_t—Federal Reserve index, 1947-49 = 100, *Federal Reserve Bulletin*, Board of Governors of the Federal Reserve System.

TABLE A-2

Link Relatives of Actual and Predicted Carloadings, All Manufactured Products, 1927-1939

YEAR AND QUARTER	ON SAME QUARTER IN PREVIOUS YEAR, *No Seasonal Adjustment*: *Actual Carloadings* ($_aY$)	*Shippers' Forecast* ($_eY$)	*Reconstituted Prediction* ($_hY$)	ON PREVIOUS QUARTER, *No Seasonal Adjustment*: *Seasonal Coefficient* ($_sX$)	*Actual Carloadings* ($_aX$)	*Reconstituted Prediction* ($_hX$)	ON PREVIOUS QUARTER, *With Seasonal Adjustment*: *Actual Carloadings* (^s_aX)	*Reconstituted Prediction* (^s_hX)
1927:								
III	—	—	—	0.945	0.983	—	1.040	—
IV	—	—	—	0.851	0.883	—	1.037	—
1928:								
I	—	—	—	1.015	1.017	—	1.002	—
II	0.986	1.040 ○	1.028 ○	1.217	1.118	—	0.919	—
III	1.003	1.056 †	1.064	0.948	1.000	1.061	1.055	1.115
IV	1.056	1.056 △	1.064	0.864	0.930	0.939	1.076	1.096
1929:								
I	1.039	1.059 †	1.071	1.007	1.000	1.031	0.993	1.027 ○
II	1.108	1.056	1.064	1.204	1.192	1.145	0.990	0.945
T III	1.058	1.044	1.037	0.950	0.955	0.937	1.006	0.981 ○
D IV	0.947	1.038 ○	1.023 ○	0.877	0.832	0.901	0.947	1.035 ○

[table continues on next page

TABLE A-2, *continued*

YEAR AND QUARTER	ON SAME QUARTER IN PREVIOUS YEAR — *No Seasonal Adjustment*			ON PREVIOUS QUARTER — *No Seasonal Adjustment*			*With Seasonal Adjustment*	
	Actual Car-loadings $({}_aY)$	*Shippers' Forecast* $({}_eY)$	*Recon-stituted Prediction* $({}_hY)$	*Seasonal Coef-ficient* $({}_sX)$	*Actual Car-loadings* $({}_aX)$	*Recon-stituted Prediction* $({}_hX)$	*Actual Car-loadings* $({}^s_aX)$	*Recon-stituted Prediction* $({}^s_hX)$
1930:								
T I	0.931	0.975	0.881	1.000	0.983	0.930	0.984	0.933
II	0.847	0.966	0.860	1.192	1.084	1.101	0.910	0.919
III	0.765	0.923	0.763	0.952	0.863	0.860	0.906	0.899
IV	0.761	0.927	0.772	0.891	0.827	0.838	0.926	0.951
1931:								
I	0.747	0.916	0.750	0.993	0.965	0.965	0.972	0.973
II	0.763	0.935	0.722	1.179	1.109	1.050	0.941	0.891
III	0.758	0.921	0.759	0.955	0.857	0.857	0.898	0.895
IV	0.729	0.921	0.759	0.905	0.795	0.829	0.879	0.924
1932:								
I	0.652	0.928	0.774	0.986	0.862	0.124 ○	0.875	1.043 ○
II	0.633	0.869	0.643	1.167	1.076	1.090	0.923	0.924
III	0.657	0.843	0.584	0.957	0.890	0.787	0.931	0.816
IV	0.802	0.910	0.736	0.918	0.971	0.884	1.057	0.973 ○
1933:								
T I	0.840	0.951	0.826	0.979	0.903	0.888	0.923	0.911
U II	1.045	0.923 ○	0.763 ○	1.155	1.339	0.975 ○	1.160	0.841 ○
T III	1.297	1.116	1.199	0.959	1.105	1.025	1.152	1.062
IV	1.149	1.149△	1.276	0.932	0.860	0.955	0.923	1.035 ○
1934:								
I	1.347	1.107	1.179	0.972	1.058	0.929 ○	1.089	0.549 ○
II	1.173	1.148	1.274	1.143	1.166	1.266	1.021	1.099
III	0.955	1.058 ○	1.050 ○	0.962	0.900	0.990	0.936	1.025 ○
IV	1.006	1.039†	1.025	0.946	0.906	0.924	0.958	0.986
1935:								
I	1.061	1.055	1.062	0.965	1.116	1.116	1.156	1.161
II	0.995	1.058 ○	1.068 ○	1.131	1.093	1.173	0.966	1.032 ○
III	1.105	1.082	1.123	0.964	1.000	1.016	1.038	1.050
IV	1.258	1.129	1.229	0.960	1.032	1.011	1.074	1.062
1936:								
I	1.116	1.110	1.186	0.959	0.990	1.051 ○	1.033	1.102
II	1.233	1.111	1.188	1.119	1.207	1.166	1.079	1.034
III	1.249	1.095	1.152	0.976	1.013	0.936 ○	1.048	0.963 ○
IV	1.231	1.118	1.204	0.974	1.107	0.966 ○	1.044	1.033
1937:								
I	1.228	1.135	1.242	0.952	0.988	1.000	1.037	1.052
T II	1.142	1.116	1.199	1.107	1.122	1.181	1.014	1.059
T III	1.081	1.093†	1.141	0.969	0.959	1.019 ○	0.989	1.046 ○
D IV	0.863	1.048 ○	1.068 ○	0.989	0.812	1.008 ○	0.821	1.028 ○
1938:								
I	0.738	0.878	0.664	0.946	0.845	0.759	0.894	0.800
T II	0.699	0.816	0.523	1.095	1.063	0.789 ○	0.971	0.713
U III	0.749	0.792	0.467	0.972	1.027	0.640 ○	1.057	0.654 ○
T IV	0.976	0.976△	0.883	1.003	1.058	0.958 ○	1.054	0.964 ○
1939:								
I	1.120	1.126†	1.222	0.940	0.970	1.059 ○	1.032	1.132
II	1.161	1.134	1.240	1.084	1.102	1.179	1.017	1.080
III	1.162	1.084	1.125	0.974	1.113	0.995 ○	1.055	1.019
IV	1.223	1.119	1.208	1.018	1.113	1.099	1.093	1.090

For the meaning of the symbols used, see the list in this Appendix.
Source: calculated from Table A-1.

COMMENT

DAVID C. MELNICOFF, The Pennsylvania Railroad

The focus of Albert Hart's paper is not on forecasting as such, but rather on the role of forecasts as indicators of businessmen's expectations. If expectations can be measured and related to business fluctuations, we might, indeed, have a "powerful testing device" for cyclical analysis and theory—provided, of course, that expectations and their fulfillment or denial engender a consistent pattern of stimulus and response over time. The shippers' advisory board forecasts seem a likely source of data, but it is not yet clear just how useful these data can be.

Hart was dissatisfied with earlier analyses of the shippers' forecasts not only because the results just did not *feel* right in view of his theoretical predilections, but also because of some other experience with the behavior of anticipations data and the testing of survey results. His new analysis and his statistical results—though even rougher than he concedes—are impressive. His hypothesis, which follows suggestions of Ferber, Hastay, and others, has much to recommend it. At least, it jibes with some of my own experience. The correction for what appears to be a systematic bias yields the kind of results that make sense: that is, they do not violate most conceptions of what expectations ought to be. It is impressive—but not completely convincing.

An old story, told with many variations, is apropos. Once a lion tamer who had just received a large and ferocious beast from the African jungles was preparing to enter the lion's cage, in purple tights and armed only with a short stick. A friend tried to stop him, but the trainer insisted he would have no trouble. "You see," he said, "my theory is that purple tights set up an emotional disturbance for the lion which renders him incapable of any violence so long as I hold the stick. I have great confidence in this theory, and I know it will work out." "Yes," said the friend, "you know the theory—but does the lion?"

Now, in contrast with the lion tamer's foolish theory, Hart sets forth an eminently reasonable hypothesis. I am sure, however, that the traffic managers who report to the advisory boards do not know that this is the way they are supposed to operate! And I question whether the assumed conditions remained stable during the entire period under review. We cannot know to what extent they prevailed without reviewing the procedures and forecasts of individual firms and of the chairmen of commodity groups. Given the age distribution of traffic managers, few of the individuals involved in the interwar forecasts are still available for interview. But one might interview those who are currently making the forecasts and compare current performance with that of the interwar years. This might provide not only some insight into the problem by analogy but also direct evidence on whether the forecasting procedures used today are the same as those of thirty years ago.

The tests suggested by Hart are helpful but not conclusive. In particular, the second, which relates shippers' forecasts to changes in the earlier part of the year, is subject to varying interpretation, and even the calculated regression coefficients do not seem to tell a consistent story.

Of course, the statistical correction for understatement of year-to-year change does not depend on or grow out of the assumptions of the hypothesis. Though it is probably essential to the analysis that the forecasts were made in relation to the level of carloadings of the previous year rather than to that of the previous quarter, the hypothesis is only one possible explanation of why the data behave as they do. One can readily agree on the probability of the year-to-year forecast yet not believe that there are only two large groups of forecasters with only two forecasting patterns. The forecasts are made by many highly diversified groups and thus exhibit a large variety of errors and many different types of bias.

What the data show is that forecasters—in the aggregate—make year-to-year predictions in the right direction, but usually go only about half as high or low as they should. On correcting for bias the results come close enough to the "actual" outcome to appear reasonable. But even aside from the omission of turning-point situations, the statistical results allow one to say only, "These are the expectations of one large group—the only group we need consider because the other group is not registering its expectations at all." In fact, uninformed guesses of year-to-year changes with no relationship to the decision-making process of the firm can come so close to the actual results that Hart's statistical methodology cannot differentiate them. The shippers' expectations could be completely without rhyme or reason, rather than neatly divided, and the statistics alone would not disclose this.

The corrected forecasts lag, they do not lead; there is little in these data which guarantees to the railroads a better tool for forecasting car requirements. Nevertheless, they may show sufficient promise to warrant looking for predictors among some of the individual series. More rigorous and detailed tests should be undertaken. In the meantime, one must be wary of taking the adjusted forecasts as firm expectations of a significant group of business firms and using them as though they were a reliable tool in business cycle analysis. We do not yet have such a tool, but Hart's paper suggests that we may someday be able to fashion one.

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Albert Hart gives no serious attention to Hultgren's study, an unfortunate omission because Hultgren's excellent brief article made an important contribution to the subject.[1] His essential point was that the shippers'

[1] Thor Hultgren, "Forecasts of Railway Traffic," *Short-Term Economic Forecasting*, Studies in Income and Wealth, Vol. 17, Princeton University Press for the National Bureau of Economic Research, 1955.

unsatisfactory view of nonseasonal changes over the recent three-quarters of a year had adverse effects on their comparisons of freight car requirements one quarter ahead with those of the same quarter in the previous year.

Professional economists and statisticians generally accept the advantages of using seasonally adjusted data when analyzing recent changes in the economy. Such data show up underlying changes more clearly than unadjusted data do and are essential if changes in a six-month period, in particular, are to be evaluated at its close.[2] Yet in my experience business firms rely heavily on comparisons of current operating statistics with those of the same month a year previous and tend to draw conclusions on recent changes in them. For the individual firm and industry, however, such comparisons can frequently lead to incorrect conclusions and contribute to incorrect anticipations. Thus to the shippers who make rather accurate forecasts and to the many who estimate "same as last year" should probably be added a group of companies whose forecasts are poor because their conclusions are based on an incorrect assessment of recent developments, and there is some evidence that the last group is significant. Seasonal variations, which are relatively more important for individual firms and industries than for industry as a whole, can affect the views of businessmen on the recent past and, therefore, their short-run outlook.

Hart raised this point, but it is also relevant to the volume as a whole. It contains no serious discussion of seasonal factors in business operating statistics, of whether the treatment of seasonal factors by businessmen has been adequate, and of whether, if inadequate, the inadequacy had any effect on businessmen's expectations. However previous studies have recognized the problem, and Ferber has indicated that further empirical data are being gathered that may throw light on it.

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Whatever the implications of Ferber's data or Hart's revaluation of them, it is interesting to note the grounds on which truly "regressive" expectations may be rationalized. These relate to possibilities of intertemporal substitution and suggest that there should be at least a component of expectations which is regressive.

Data collected from one large shoe manufacturer in the course of a study of expectations and investment revealed a sharp negative correlation between preseason or early season orders and those of the balance of the season. A ready explanation lies in the stability of shoe demand—more early buying means less later buying. Thus where sales were higher during

[2] For an excellent article covering this point and giving some results from the use of electronic computers to compute seasonal adjustments, see Julius Shiskin, "Electronic Computers and Business Indicators," *Journal of Business*, October 1957, reprinted as Occasional Paper 57 by the National Bureau of Economic Research.

the first two months of a season than in the corresponding two months the year before, they would tend to be lower in the ensuing months than in the same period the year before. If actual sales changes proceed in this regressive fashion, a similar regressive character in expectations would hardly be surprising.

An opportunity to observe this relationship again was found in the McGraw–Hill data at my disposal. In late 1949, McGraw–Hill respondents were asked for the percentage figure by which they expected 1950 sales to depart from 1949 sales. When the expectations were related to actual 1948-49 percentage sales changes, the simple linear correlation was found to be virtually zero. However, some nonlinear correlation was apparent. Higher sales were expected in greater proportion both by firms whose sales had increased the most (10 per cent or more) and by those whose sales had decreased the most (more than 20 per cent). Among firms expecting some change in sales, increases were expected by 75 per cent of the above "extremes" as against only 47 per cent of those with moderate sales-change experience. (Tschuprow's T was 0.25, significant at the 1 per cent level, and the tetrachoric coefficient of correlation was 0.42.)

If one assumes that a high proportion of firms with large 1948-49 sales changes were also long-run growth firms, data on past capacity changes can be used to enlighten this relationship. And the relation between sales-change expectations and prior changes in capacity was found to be strongly positive. For the 1939-48 changes in capacity ($T=0.36$) and 1947-48 changes ($T=0.25$) the correlations were significant at the 1 per cent level.

More and better data will certainly be needed to formulate more than a tentative hypothesis. But the findings touched upon here are at least not obviously inconsistent with a theory I have proposed elsewhere that short-term sales expectations are compounded of two elements, the long-term trend (with which short-term sales expectations are positively correlated) and short-term deviations from the long-term trend (with negative correlation). Whatever the direction of the long-term trend, a short-term sales change that deviates markedly from the long-term expectations may be seen as essentially stochastic and thus lead to expectations of a reversal back toward the trend in the following year.[1]

[1] Robert Eisner, "Expectations, Plans and Capital Expenditures: A Synthesis of Ex Post and Ex Ante Data," *Expectations, Uncertainty and Business Behavior*, Mary Jean Bowman, ed., Social Science Research Council, 1958, esp. p. 162.